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DRAFT REPORT

ACCESSIBILITY DESIGNED TAXI SERVICE FOR BOSTON

Market Demand and Operational Considerations

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EXECUTIVE SUMMARY

The "bottom line" of this paper is the demonstration that even if every newly issued medallion is restricted to an accessible vehicle, there will still be significant degradation of service available to disabled patrons. Although those needing or desiring accessible vehicles will be able to mitigate this degradation by summoning service by phone, service deficiencies will effectively preclude reliable utilization of street hailing and cab stands. Even with phone-summoned service, excess delays for disabled patrons will range from more than 100% up to more than 1000% if only 50 vehicles are accessible. Given this analysis, the burden of proof is clearly on those who would suggest the authorization of any additional inaccessible taxi service. In exercising its discretion cited by DPU, the City must justify, if it can, the perpetuation of this discrimination: otherwise the City must tie the issuance of new medallions to fully accessible vehicles.

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I. INTRODUCTION

The Massachusetts Department of Public Utilities, in a ruling issued March 14, 1990 has found that the City of Boston, in issuing new taxi medallions, "is obligated by its statutory mandate to require that a reasonable portion of the additional medallions be used to ensure that wheelchair accessible taxi service becomes available in Boston." It is left to City officials to determine what numbers of accessible vehicles are required to provide such service.

This paper examines the potential demand for accessible taxi service, the operation of taxi service currently available in Boston, and the likely impact of the deployment of a "mixed fleet" of accessible and inaccessible taxi vehicles. The analysis demonstrates that any level of inaccessible vehicles in the fleet degrades the service available to disabled patrons: a conclusion not contradicted by common sense. The larger the proportion of inaccessible vehicles, the greater the service degradation, particularly regarding street-hailed and cabstand service. We conclude that 300 accessible cabs will be required to have a significant impact upon phone-summoned cab service available to disabled patrons. Service degradation is, however, still at unacceptable levels with 500 accessible vehicles, with a doubling of waiting times for phone-summoned service and severely reduced likelihood of finding street-hailed or cabstand service.

This paper makes several assumptions regarding taxi service and the disabled population which seem obvious when stated but which are often overlooked. Foremost is that disabled patrons

want to use taxicabs for the same reasons and under the same conditions as the rest of cab users. Taxicabs permit spontaneous travel between locations not necessarily served by public transit, facilitate the transport of parcels and luggage and offer a particularly flexible, private and efficient mode of travel. Service can be summoned by phone, sought at cab stands or hailed on the street. Any "reasonable portion" of accessible taxicabs will need to duplicate each of these characteristics in the service available to disabled patrons or else it will unfairly discriminate against that population.

A second assumption is that accessible cabs will be usable and used by all of the taxi-using public and not a specialized, segregated part of the fleet for use only by the disabled. In fact, we can expect that these vehicles will be found especially useful by some patrons without disabilities: travelers with luggage or parents with baby-strollers, for example. With a larger universe of potential customers, operators of accessible vehicles will have a definite business advantage. Such advantage can exist, however, only when a sufficient portion of the fleet is accessible so as to allow those desiring to utilize such vehicles the assurance that these cabs will be available when and where they are needed.

Finally, the decision of the DPU to expand the taxi fleet is seen as a unique opportunity to make accessible another mode of transportation with no effective cost to the public. Recognizing that accessible vehicles are somewhat more expensive than the currently used sedan, it seems appropriate that some of the

"windfall" created by the difference in cost between new and existing medallions be utilized to meet this service demand. The creation of these new medallions is literally a once-in-a-generation opportunity to expand service where none has existed before.

These factors, together with the consideration of the civil and constitutional rights of disabled persons and well-established public policy regarding access, underlie the conclusions of this paper. These rights derive from the obligations of a common carrier and from the mandate of Article 114 of the Massachusetts Constitution which forbids discrimination against the disabled in activities public and private. Taxicabs are public accommodations under both federal and state law and as such are prohibited from discrimination. The fact that taxicabs are regulated as a public utility underscores the importance that their service be available to all of the public. Together these laws place an affirmative obligation upon the City to ensure that cab service is available to disabled patrons and available in a meaningful way.

Because access to these services is indeed a civil right, the provision of service is required and not conditioned solely upon the demand anticipated for that service. The situation in public transit is certainly analogous and instructive. Massachusetts public transit policy, since 1985 at least, has required that all new vehicles purchased with public funds be accessible to persons with disabilities. Obviously this is not based on the assumption that every vehicle on every run is likely

to carry a passenger using a wheelchair. This policy is based, instead, on the recognition that use of this service is a matter of right and that effective use of the service depends upon the existence of a "critical mass" of accessible vehicles. In the early days of this policy, when accessible vehicles were few, utilization was minimal: the chances of finding an accessible vehicle were too low to ensure a successful trip. As the number of accessible vehicles grew, however, demand increased at a far faster rate. In effect, the policy requiring accessible vehicles created the demand for such service. Especially for a community of people whose opportunities for work and recreation as well as transportation have been so very circumscribed, it is difficult or impossible to know precisely what demand will be for a service not now available. This paper attempts to estimate that demand, using local data and the experiences of other cities where accessible service is now available. We can reasonably expect, however, that an increasingly open and accessible society will reward the investment in accessible transportation with substantial new growth - growth that will in fact help sustain the original decision to increase the total number of cab medallions.

II. Identifying the potential demand for accessible cab service.

The potential market for accessible taxi service is quite large. The Governor's Commission on Accessible Transportation (1987) reported that there were 104,693 persons over the age of 16 who reported having transportation handicaps residing in the communities served by the MBTA. An estimated 72,000 persons in Boston are transportation handicapped: over two-thirds of these potential riders have difficulty or cannot use existing cabs. Because accessible cabs will be required by persons with temporary disabilities and will be available as well to able-bodied patrons who may want or need their particular features, a definite and substantial market awaits these vehicles. Existing means of mass transit, paratransit and chaircar service are often either inadequate or inappropriate to meet these needs. Experience in other markets, most notably in Great Britain and in Canada, has demonstrated strong demand for such service.

II.1 The Transportation Handicapped and the Demography of Disability in Boston

Although persons with disabilities will only be a part of the total market using accessible cabs, it is this population which has given impetus to, and provides the service base for, re-configured taxicabs. Not all persons with disabilities are unable to utilize current sedans but for most of those who cannot, it is the design of these cabs, not the nature of the disability, which precludes taxi use. For this reason, we will refer to that portion of people with disabilities as "transportation handicapped."

Table I provides information, derived from 1980 Census data, that indicates the total population and the numbers of those who are "transportation handicapped". Two points are most striking: (1) the Boston population has a higher rate of transportation handicap than does the state and (2) the elderly population has a much higher rate of transportation handicap than the younger population, both for the state and for Boston. Although lacking statistics on institutionalized individuals, people under 16 and those with short term transportation handicaps, the rate of transportation handicaps is 3.7% statewide and 5.3% in the city.

The Boston rate of 5.3% is the same as figures developed by Applied Resource Integration, Ltd., based upon 1977 population data. This study further suggests that if those under age 16, or who are institutionalized or have temporary disabilities are included, the number of transportation handicapped increases to about 7% in Boston.

Table II provides more recent population estimates, segmented by a range of transportation handicaps. These data reflect the fact that a significant portion of persons with disabilities, although potentially able to utilize current cab vehicles, would benefit from utilizing a truly accessible vehicle. This market, inadequately or inappropriately served by the cab industry today, represents an important source of growth in service and revenues. Experience in Canada indicates, moreover, that this part of the population will be disproportionately large users of taxi service if it is accessible. (see below).

TABLE I: Public Transportation Disability (Age 16 and Older, Non-institutionalized Population)

	Massachusetts	Boston
Total Population	5,737,037 (a)	562,994 (b)
Public Transportation Disability (c,d)		
Age 16-64	63,158 (1.7%)	10,995 (2.9%)
Age 65+	98,365 (14.5%)	12,768 (19.8%)
Age 16+	161,523 (3.7%)	23,764 (5.3%)

NB: Disabilities lasting less than six months are not included.

Sources: US Census, 1980-Question #19

- (a). General Social and Economic Characteristic, Table 62
- (b). Census Tracts, Table P-1
- (c). General and Social Economic Characteristics, Table 70
- (d). Census Tracts, Table P-10

TABLE II: ESTIMATES/POPULATION AND PEOPLE WITH DISABILITIES:
TOTAL & TRANSPORT SPECIFIC

	TOTAL POP.	PEOPLE WITH DISABILITIES	MASS TRANSPORT DISABLED	DIFFICULTY USING TAXIS	UNABLE TO USE TAXIS	DISABLED BENEFITING FROM ACCESSIBLE TAXIS
% based upon total population		17% (d)	8% (e)	6% (f)	1% (g)	7% (h)
Massachusetts	5,832,000 (a)	991,440	466,560	349,920	58,320	408,240
Greater Boston	2,845,000 (b)	483,650	227,600	170,700	28,450	199,150
Boston	574,220 (c)	97,617	45,938	34,453	5,742	40,200
Potential Transport Consumers in Boston Daily	900,000 (h)	153,000	72,000	54,000	9,000	63,000

These general numbers tell only part of the story regarding the characteristics of the disabled population, however. Various studies have demonstrated that the proportion of persons with disabilities in the general population has grown and will continue to grow. Increased longevity generally and improved health care and life quality for disabled persons have brought this population out of their homes and from institutionalized settings. This effect will grow in importance as the "baby boom" of the 1940's and 1950's ages. And reflecting this change in the disabled population is an increase in the need and desire for accessible transit in all forms. Complying first with state laws and now with federal legislation, places of employment, public accommodations and recreation facilities are all becoming increasingly accessible. Federal law will soon require access for the disabled on intercity rail service and airlines. The cumulative effect is an increasing population requiring ever more accessible transportation service.

II.2 The Disabled Visitor:

Out-of-town business people and tourists

The discussion above demonstrates that there is within Boston itself a substantial base for a market for accessible cab service. An important part of the taxi market generally - tourists and businesspeople from outside the region - is also being impacted by these demographic and social changes. Tourism authorities recognize the elderly and disabled as particularly avid travelers. Increased job opportunities for people with disabilities also means increased business travel. These factors

lay behind a major new expansion in accessibility features at Logan Airport now being undertaken by MASSPORT. Without accessible taxicabs, however, these improvements will end at the terminal door.

II.3 Other Users of Accessible Vehicles

While the potential demand for accessible cabs in Boston is strong and growing, it is recognized that much of their utilization will be by persons who do not need these vehicles because of a disability. There can be no segregated part of the taxi fleet and no premium for using an accessible vehicle. Some of these able-bodied users may have specific reasons for desiring these accessibility designed vehicles. Persons carrying large or numerous parcels or pieces of luggage or traveling with a baby-stroller will seek out these cabs as will those whose physical size makes conventional cabs uncomfortable. Accessibility designed cabs will provide room for somewhat larger parties, possibly seating five persons comfortably. Indeed, the especially desirable aspects of these vehicles could create a workload demand imbalance in their favor. For consideration of demand, however, it is critical to remember that the real demand is the sum of disabled patrons who require such cabs because of a transportation handicap plus those who for other reasons prefer such a vehicle plus those whose use is casual, that is, because an accessible cab is what is available at the moment.

II.4 Indicators of demand for accessible taxi service

Although accessible cab service is clearly a supplement to existing modes of accessible transit, utilization of present transit service provides important indicators of demand. Accessible mass transit is available on buses and at an increasing number of rapid transit stations in Boston and surrounding communities. (Access to the largest line in the MBTA system - the Green Line trolleys - is still a number of years off, however.) In addition to its accessible fixed route system, the MBTA also provides a paratransit service, known as the RIDE. Other paratransit services are provided by private chaircar service: because of their very high costs (typically \$20 each way), however, these private vehicles are used almost exclusively where third-party reimbursement such as Medicaid is available. The level and characteristics of demand for these transit services support the need for a high level of accessible taxi service.

II.4.1 Accessible fixed-route service

The MBTA has undertaken a program to make its entire system accessible to persons with disabilities. Although that goal is not yet achieved, what has been accomplished has tapped a major un-met demand. As of June 1990, 12,084 persons had qualified for the special discount the MBTA provides to persons with transportation handicaps. This figure, while impressive, is obviously only a part of the potential demand for accessible cab service. Disabled persons not living near transit lines, those

whose disability makes the use of even accessible mass transit difficult or unsafe and disabled commuters and visitors from outside the state, or others unaware or unfamiliar with the available public transit system, are all potential cab users.

Although the MBTA can only estimate the actual utilization of its service by persons with transportation handicaps, utilization of the Call-A-Lift Program, which schedules accessible buses to meet the travel needs of disabled customers, grew dramatically until it was offset by an increase in fully-accessible routes. In 1989, specially scheduled lift trips totalled 4,607. Even this figure conceals potential taxi demand. Passengers who utilize the "kneeling bus"¹ feature on MBTA buses go uncounted, for example. Such persons would certainly benefit from accessible cabs over current sedan cabs.

Again it must be emphasized: the growth of accessible mass transit and the need for accessible taxi service are complimentary, not potential substitutes one for the other. As expectations regarding mobility increase, moreover, we may expect demand to continue to increase for both in a sort of symbiotic fashion.

II.4.2 Paratransit in Boston

The RIDE, the paratransit system of the MBTA, is a well-established part of public transit service. The MBTA has greatly expanded the service since its inception in 1977, both in the service area covered and in the number of trips provided. As of January 1990 7,571 persons were registered for the RIDE in Boston

(1) A "kneeling bus" is a bus that can be lowered in the front to reduce the entrance step height.

alone, up 20% from the year before. In May 1990, 22,532 trips were completed in the metro-Boston CORE Area, an increase of 15% from the year before. Forty four of the MBTA's 78 number municipalities, including 82% of the metropolitan area population are now in the RIDE service area, and MBTA policy calls for continued expansion to all 78 communities.

Soon to be adopted Federal law as well as MBTA policy ensure that the RIDE will continue its robust growth in coming years. The nature of paratransit, however, means that this service cannot be seen as a substitute for accessible cab service. RIDE service must be reserved at least 24 hours in advance, or booked for a set, regular time for daily trips to work or school. Because RIDE trips are shared, trip times are often much longer than a direct route could provide and arrival or departure at a specific desired time cannot be guaranteed. Spontaneous travel for a movie, family visit, or to stay late at work are equally impossible. These limitations undoubtedly mean that the RIDE trips are only a partial measure of accessible taxi demand.

The use of private "chircars", lift equipped vehicles operated by private providers and usually under third-party payment, provides another indicator of potential demand. In 1988, the Dept. of Public Welfare purchased 76,605 chaircar trips for 11,033 Boston clients. The Massachusetts Rehabilitation Commission also purchases a significant number of trips. The very high cost of such service, typically two to three times the cost of taxi service, virtually precludes their use by the typical disabled traveler.

The experience in other communities

A study conducted for the Province of Ontario (1988) indicated that persons with transportation handicaps travel away from home at a rate from 50% to 80% below that for the entire population, which makes 2.1 trips per day. The implications of this figure is clear enough: transportation handicaps leave many disabled persons effectively housebound. Even without the availability of accessible vehicles, however, this study concluded that disabled persons used taxi service at a rate 80 times as high as the able-bodied population. Obviously, even with the major problems involved with using standard cabs, persons with disabilities find the flexibility of cab service useful. Disabled customers will certainly become an even more important part of the taxi market if the cab itself becomes more easily usable and usable by more people.

Since February 1989 all new cabs operating in London have had to be accessible to wheelchairs. At present, approximately 4,000 (or 29%) of London's 14,000 taxis are accessible. By January 1, 2000, all of London's taxis will be usable by wheelchair riders. London's accessible cabs are used by both able-bodied and disabled people. They are barely distinguishable from the inaccessible standard cabs, being the same vehicle with small modifications built in during manufacture. One wheelchair, along with four ambulatory passengers, can be transported at a time. Telescoping ramps stored in the trunk are used for boarding all motorized wheelchairs and others if necessary. Since the vehicle's floor

is lower, most drivers can load a manual chair without using the ramps if the vehicle is next to a standard curb. According to the Disability Unit of the Department of Transport, London's program has been very successful, far exceeding expectations. Despite pre-startup opposition from the taxi industry, the service has quickly been accepted by all involved. Thirty local authorities outside of London are now following London's lead and requiring accessible vehicles.

According to the Department of Transport, the benefits of the new policy are widespread.

Benefits accruing to the taxi industry include:

- Substantial contract work has come from human service providers.
- More off-peak travel has been generated.
- Some drivers are obtaining a significant portion of their income from riders with disabilities.

Benefits to passengers with disabilities are:

- More people are traveling.
- Users are traveling more frequently.
- As their confidence grows, people begin participating more fully in employment, recreation and social activities.

Taxpayers also benefit from accessible taxis:

- Financial savings accrue from reducing health and education authority expenditures.

- o It is less costly to provide mobility for people, enabling them to attend to their own needs, than to supply workers to tend to these needs.
- o They are saving money by contracting out client transportation.

III. Characteristics of the taxicab vehicle and service

The current configuration of the typical vehicle used for taxi service owes more to the caprice of auto industry economics than to ergonomic, user-friendly design. There is nothing "given" about the current sedan in use: within recent memory the Checker vehicle set the standard. Although no more accessible to wheelchair users than the currently used sedans, these vehicles were roomy, easier for most people to enter and provided significant trunk space. Although Checker has ceased production, other existing vehicles can readily be adopted to provide these characteristics plus accessibility. Adapted accessible taxis, with low floors and swing-down ramps, would be significantly different from the lift-equipped vans used in paratransit services such as the RIDE. Low-tech, existing vehicle technology can provide better services to all of the taxi market.

III.1 How Cab Design Limits Accessible Use

Standard taxi cabs cannot provide access for disabled patrons because of a number of design problems. Standard taxis require strength, balance and agility when bending, sitting down, or getting up. Inaccessibility often results because of a mobility aid that will not fit well into the taxi. Someone who uses crutches or who needs to use a power wheelchair may be substantially disabled by the same taxi. Walker users may also fall into this category. Many of these people can utilize public transportation such as taxi cabs if measures are taken to incorporate them, i.e., provision of accessible cabs.

One problem which inaccessible cabs present to disabled patrons is the typical position of a taxi seat. By projecting into the doorway, the seat largely obstructs direct passenger access to the cab, hindering a patron's entering and exiting. All patrons need to do some minor bodily contortions to lean on or grasp part of the vehicle in order to accomplish the transition. These maneuvers are difficult or impossible for persons with mobility disabilities. Standard cabs require considerable bending in a slightly reclined sitting position, and force users to exert particular effort getting out. For some riders legroom is inadequate, e.g., those with leg casts or knee braces, preventing the bending of a leg. For other riders headroom is a problem, especially those wearing head braces which immobilize the neck and upper back. The inaccessibility of taxicabs to wheelchair users especially impacts those who have more serious mobility impairments such as quadraplegics. A few manual wheelchair users who are able to transfer into a standard may be willing to use such taxis if the driver is willing to stow the wheelchair in the trunk. The majority of manual wheelchair users and all motorized wheelchair users don't have cabs as an option. Electric wheelchairs cannot be folded and stowed.

III.2 Characteristics of Accessible Cabs

For people who cannot use, or use comfortably, standard cabs, accessible taxicabs are a logical choice. The vehicles that likely will be used have higher ceilings, wider doorways and additional floor space, permitting access by passengers who could

not use or would not be comfortable in standard cabs. These accessible cabs accommodate up to two wheelchair users, 3-5 ambulatory passengers, or some number of both. Manual and electric wheelchair riders can use lower floors with ramps and can remain in their chairs during the trip. The ramps also permit easy access by individuals with leg and bending problems. Easier to use bench-type seats can be approached directly. Accessible taxicabs can transport more than one wheelchair plus ambulatory riders at one time.

III.3 Utilizing the System

Customers will choose the service they use based largely on the supply of accessible cabs -- the cab that is most reliable and that requires the least waiting. Unless the customer is located near a cab stand or near a street with heavy taxi volume, this means a telephone request. About 80 percent of taxi customers access the system by telephone. However, where there is a constant flow of taxicabs or at taxi stands, customers can hail a cab. People tend to make their travel choices based not on average wait time, but on "the worst likely wait time." One study suggests that people will monitor their experience in their last 6 trips. A worst case wait time can be more than an hour.

III.3.1 Telephone Requests

With a mixed taxicab fleet a customer requesting service by phone could choose to request an accessible cab. Some customers, such as those in motorized wheelchairs, are certain to request

such a cab. (As will be shown, the average number of available accessible cabs in a service area can be as small as 1, and even smaller).

III.3.2 Cab Stands

Customers at cab stands will either take the first cab in line, wait for an accessible cab, or take an accessible cab if one is available. In such situations, an accessible cab could be used more frequently than an inaccessible cab because there is no additional delay on the customer's part to taking an accessible cab if one is available. Obviously, disabled patrons have a higher probability of not finding a cab because they can use only a fraction of the fleet and the number of accessible cabs serving the stand will be only a fraction of what it is for the general population. In the case of less than totally accessible cab service (as expected if only 500 or fewer taxis are accessible), except at the very largest stands significantly limited service can be expected.

III.3.3 Hailing a Cab from the Street

The expected wait when hailing a cab depends on the flow of available cabs on a street. The inverse relationship between wait and number of cabs is clear. If accessible cabs represent only 10% of the taxi fleet, the wait for a accessible cab will be, on average, 10 times greater than the wait for a general cab. Most persons desiring an accessible cab will find it to their advantage to make a telephone request rather than try to hail one.

III.3.4 Logan Airport

The situation at Logan Airport has characteristics of both a telephone request and a cab stand. If one requests an accessible cab there would likely be no additional delay. Because the taxi pool at Logan is almost never empty, the wait at Logan is almost always short. The market at Logan benefits from tremendous economies of scale as companies are pooled together and there is a great concentration of demand.

In analyzing the operation of a mixed fleet system, all four ways of utilizing the system need to be considered.

IV. The Functioning of a Mixed-Taxi Fleet

A mathematical model has been developed to simulate the impacts of different fleet characteristics and supplies of accessible taxicabs upon taxicab service in a mixed accessible/inaccessible taxicab fleet in Boston. The Accessible Taxicab Operation Model predicts that a substantial number of accessible taxicabs must be incorporated into the fleet to provide reasonable and reliable cab service to disabled patrons.

IV.1 Model Description

Because telephone requests represent the majority of taxi customers, the workload impacts of this set of customers primarily has determined workload overall. The model uses the fleet's characteristics to project the fleet's workload. Individual workload is defined as the fraction of time a cab is busy serving customers (including the time spent responding to a call). The fleet workload is the aggregate complement of availability, and is therefore a critical determinant of level of service. If the workload of accessible taxis becomes too high, there will be too few available, and service will suffer.

The model estimates the number of accessible and total taxicabs in Boston outside the immediate downtown area that each cab company would use. This is the number of cabs any one dispatcher could contact in response to a request for a cab. When making a telephone request, the nearest available cab is sent. The more available cabs there are, the smaller the expected distance to that nearest cab, whether dealing with any

type of cab or accessible cabs. From a passenger's perspective, the performance of a taxi system improves with the number of taxis that are available to him/her. The mean wait time is inversely proportional to the available cabs. That is, if twice as many cabs are available, the average wait time will be half as long. The model uses the mean wait time and operational characteristics to project the time required for an average cab request (accessible or otherwise) to be filled.

IV.2 Model Assumptions

The model is based upon reasonable estimates concerning the operation of a taxicab fleet. Seventy-five percent of the total fleet is assumed to be active during peak periods. An average of 30% of those cabs is estimated to be serving the areas outside the immediate downtown portion of Boston, which has 16 cab stands (and thus 16 relatively separate service areas). These areas have been called "small" areas because they are small enough that most (90%) of the cabs in the service area will be close enough to respond to a cab request. Finally, the new medallions are assumed to be spread evenly among the cab companies serving Boston. By "company" is meant the set of cabs under control of the dispatcher the customer reaches when making a telephone request. Thus, for example, ITOA, which is strictly not one taxi company, is perceived by customers to be a single company. When making a telephone request, a customer must call a single company. The number of taxi providers in Boston is fairly substantial, some large, some small, with the small ones tending

to be geographically concentrated in a neighborhood such as Hyde Park. For any geographic area, a telephone call will typically be made to a company with about twenty percent of the cabs in that area. For example, near downtown most of the cabs belong to five companies: Checker (which purchased Yellow a few years ago), Boston Cab, Town Taxi, Red and White, and ITOA. In Dorchester, most belong to four companies: ITOA, White, Red and White, and USA Taxi. The average number of cab companies serving an area is assumed to be five.

IV.3 Model Projections

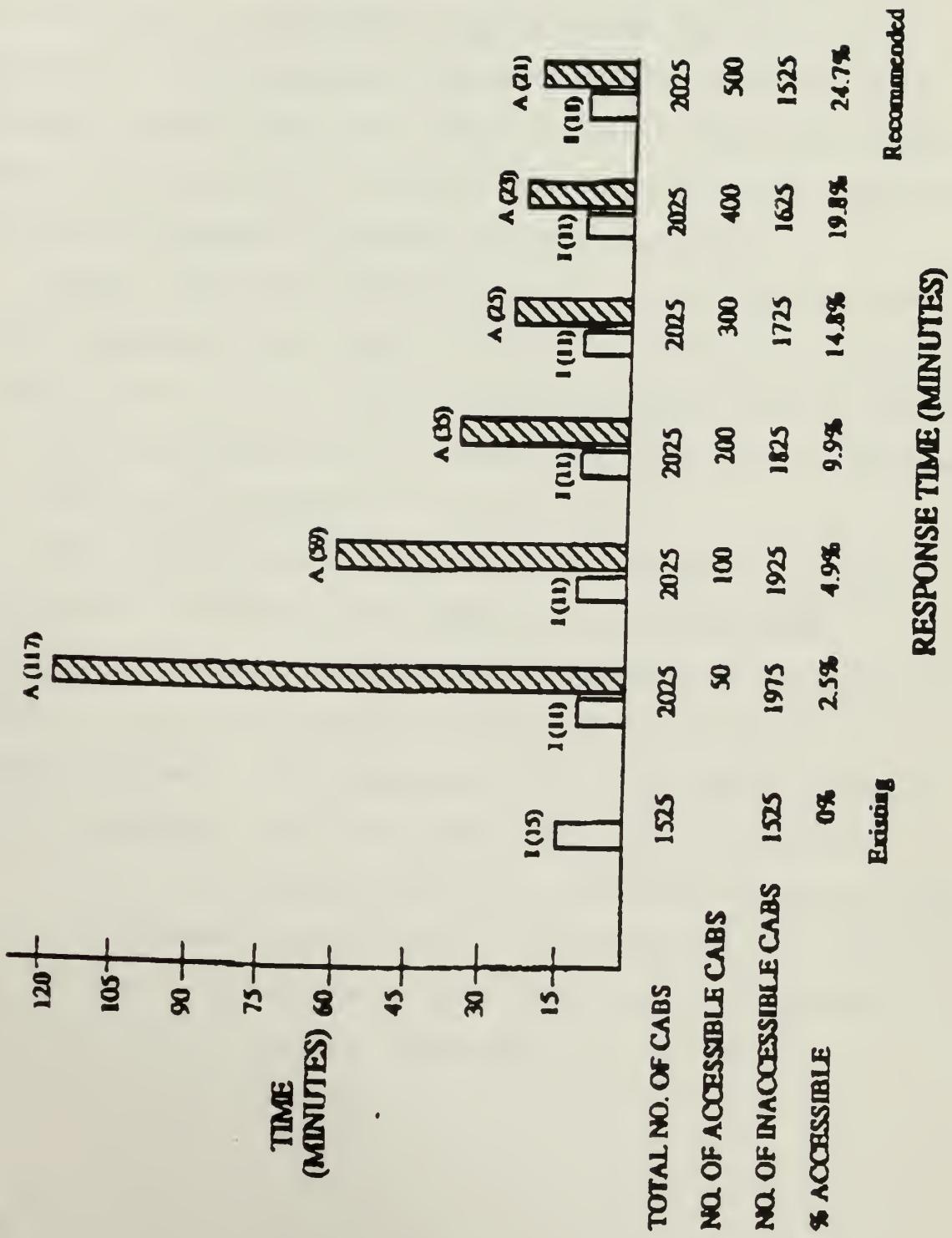
The model first projects the number of taxicabs in a service area. Six cabs will be available in each service area to each dispatcher if 500 new medallions are issued. If all 500 are restricted to accessible cabs, an average of 1.4 accessible cabs will be available in each small service area. If only 50 of the 500 are restricted to accessible cabs, one cab will cover two service area (0.5 accessible cabs per small service area). The model then finds the percentage of time which all the cabs in a typical service area will be busy based on the number of cabs and the availability rates for individual cabs, specifically 12% availability. The response times for these aggregate availabilities are then calculated using estimated processing and "deadhead" (drive time to patron) times of two and four minutes respectively and the repeated attempts to fill a cab request every six minutes.

The model's initial projections indicate a response time for an accessible cab in the case of 50 accessible cabs in excess of 4 hours. In such a case a dispatcher would certainly enlarge the area which was served by an accessible cab in an attempt to fill the request in a reasonable time period. The model was altered to simulate larger service areas for accessible cabs. These wide areas for accessible cab service divide the areas of Boston outside the immediate downtown area into 4 areas instead of into 16, effectively quadrupling the area covered by each accessible cab.

Using the wide areas for accessible cabs, the model projects the following performances based upon an individual cab availability rate of 12 percent. The results are shown in Figure 1. The response time without new medallions range is 15 minutes for all cabs (no accessible cabs are available in this case). These times are in agreement with anecdotal evidence of the existing performance of the fleet. The addition of 500 medallions is projected to reduce this wait time to 11 minutes. As expected, the performance of the fleet for its disabled patrons is highly dependent on the number of accessible cabs. With only 50 accessible cabs, response time is 117 minutes (almost two hours) for an accessible cab. This is over 10 times longer than the wait for any cab under the same conditions. If all of the 500 medallions are restricted to accessible cabs, the response time is still 21 minutes. While this time is much improved, it remains nearly twice as long as the response time for other customers.

A fleet of accessible taxicabs must be large enough to provide reasonable service to its customers. Based upon consistent, reasonable levels of service, these customers will develop confidence in accessible cabs as a reliable means of transportation and will increase their use of taxicabs. However, this level of service, confidence, and increased demand will not develop if the number of accessible cabs is small. The model clearly shows that a small or "trial" fleet of accessible taxicabs is insufficient to provide reasonable, reliable service to its customers. Introducing a small trial fleet will almost guarantee a low demand and low use.

FIGURE 1: TAXI CAB RESPONSE TIMES



V. Policy Implications

The foregoing analysis demonstrates two important facts. First, a large and almost completely unmet demand exists for taxi vehicles that are accessible to people with transportation handicaps. These "universal design" vehicles will provide an important service to all cab users and can be expected to help sustain the high level of overall demand which led to the basic decision to increase the number of medallion cabs.

Second, the model developed makes it clear that the level of service mandated by the Dept. of Public Utilities for disabled patrons, as well as the benefits accruing from improved design for other customers, can be effected only if all new medallions are tied to the utilization of such vehicles.

Given these conclusions, the burden of proof to justify allowing the creation of new inaccessible service seems impossible to sustain. Given the availability of an accessible vehicle to the taxi industry and the clear civil right of the disabled customer to the service of that cab, how can that service be denied? It is the characteristics of the taxi vehicle, not of the disabled customer, that creates the handicap. The City of Boston can now move in a meaningful way to eliminate that handicap. It would be a major loss to all the people of Boston if this very special opportunity is not taken.

